

configured to engage the back end of the movable member inside the outer body and move it forward as the cap is moved to the closed position; and

whereby closing the cap causes the movable member to move forward while the retraction body is restrained by the hub in the outer body thereby releasing the retraction body from the movable member.

2. The combination of claim 1 wherein the wall of the tubular outer body has a portion of the wall behind the front end which is thickened to create a stepped portion on its inner surface which cooperates with the outer surface of the front portion of the movable member to create said tight area whereby the movable member is held in a forward position.

3. The combination of claim 2 wherein the outer surface of the front portion of the movable member is radially enlarged relative to the wall of the movable member to cooperate with the stepped portion on the inner surface of the outer body to create the tight area which holds the movable member in a forward position.

4. The combination of claim 2 wherein a rear portion of the wall of the movable member has an inner surface which is stepped inwardly to form a constriction which will catch the retraction body when it retracts and prevent it from escaping from the movable member.

5. The combination of claim 1 wherein the retraction body carries a needle holder with a needle extended through the front of the outer body.

6. The combination of claim 5 wherein the retraction body has a centrally located opening for securing said needle holder which can be installed from the front of the assembled device.

7. The combination of claim 6 wherein said centrally located opening is formed by a forwardly extending tubular wall which in cooperation with the hub serves to confine said biasing means between the hub and the retraction body.

8. The combination of claim 5 wherein said cap has an outer rim larger than the opening in the back of the outer body and an inner rim comprising two camming protrusions which are spaced apart and positioned to enter said opening when the cap is moved to the closed position.

9. The combination of claim 8 wherein said protrusions are oppositely positioned along the inner rim about half-way from the hinged connection.

10. A cap operated retractable medical device combination comprising:

an elongated outer body having a partially closed front, an open back and an intermediate wall portion connecting the front and back; wherein the intermediate wall portion has an inner surface that defines a hollow interior and an opening at the back;

a cap which is selectively positionable with respect to said opening between an open position which allows access to the hollow interior and a closed position which blocks said opening, said cap having a camming protrusion which moves through the opening when the cap is moving to the closed position;

while proper *X* an elongated movable member shorter than the outer body and contained therein, the movable member having a wall configured to define an external surface in close proximity to the inner surface of the wall of the outer

0057604463950

body, an internal surface which defines a cavity therein and an open back end which serves as a contact surface for the camming protrusion on said cap; and there is a front end portion of the movable member with radially enlarged inner and outer surfaces;

a retraction body releasably held by the movable member at the radially enlarged inner surface of the front end portion of the movable member;

the radially enlarged surface of the movable member being slidably held by a portion of the inner surface of the outer body at a location spaced behind the partially closed front of the outer body;

means for preventing forward movement of the retraction body and biasing means adapted to apply a retraction force to the retraction body; and

whereby the retraction body may be released from the movable member for retraction by forward movement of the movable member caused by positioning the cap into the closed position while the retraction body is restrained by said means for preventing forward movement.

11. The combination of claim 10 wherein the retraction body carries a needle holder with a needle extended through the partially closed front.

12. The combination of claim 11 wherein the partially closed front comprises a hub centered along the longitudinal axis of the device.

13. The combination of claim 12 wherein the retraction body has a laterally extending discoid wall having an outer facing edge which is held by the radially enlarged inner surface of the front end portion of the movable member.

14. The combination of claim 13 wherein the retraction body has a centrally located opening for securing said needle holder wherein said needle holder can be installed from the front of the assembled device.

15. The combination of claim 14 wherein said centrally located opening is formed by a forwardly extending tubular wall which in cooperation with the hub serves to confine said biasing means between the hub and the retraction body.

16. The combination of claim 15 wherein the biasing means comprises a coil spring which closely circumscribes the tubular wall of the retraction body thereby stabilizing the retraction body as it retracts.

17. The combination of claim 10 wherein said cap is hingedly connected at the back of the outer body to pivot at the hinge between said open and said closed position thereby positioning said protrusion to engage the contact surface on the movable member to cause said forward movement of the movable member when the cap is moved to the closed position.

18. The combination of claim 17 wherein said cap has an outer rim larger than the opening in the back of the outer body and an inner rim comprising two camming protrusions which are spaced apart and positioned to enter said opening when the cap is moved to the closed position.

19. The combination of claim 18 wherein said protrusions are oppositely positioned along the inner rim about half-way from the hinged connection.

20. A cap operated retractable medical device in combination comprising:

a tubular outer body having a front end portion, a back end portion and an open back end;

the tubular body having a movable cap at its back end which is movable from an open position to a closed position wherein the movable cap closes the open back end of the tubular outer body;

a needle bearing retraction body being retractably held in the tubular outer body with the needle exposed, the retraction body being retractably responsive to movement of the cap from its open to its closed position; and

whereby the action of closing the cap closes the open back end of the tubular outer body and causes the needle bearing retraction body and needle to be retracted

0057604699950



CH
A,

22. The combination of claim 20

wherein the movable cap is normally open
and movable from the normally open to the
closed position.

23. The combination of claim 22
wherein the cap is hingedly supported at the
back end of the tubular outer body for
movement from the normally open to the
closed position.

24. The combination of claim 20
wherein the needle bearing retraction body
is retractably held by a movable member
which moves in response to the action of
closing said cap.

25. The combination of claim 24
wherein the movable member has a mouth
having an inner surface which retractably
holds the retraction body.

[Handwritten signature]

THE UNIVERSITY OF CHICAGO

26. The combination of claim 25
wherein the needle bearing retraction body
is retractably held within the mouth of the
movable member by means of a sliding
interference fit.

27. The combination of claim 24
wherein the front end portion of the tubular
outer body has a hub which serves to release
the retraction body from the moveable
member as the moveable member moves in
response to the action of closing the cap.

28. The combination of claim 24
wherein the movable member has an outer
surface being slidably held by means of the
inner wall surface of the tubular outer body.

29. The combination of claim 24
wherein the cap engages the movable
member to move the movable member
forward to thereby release the retraction
body in response to the action of closing the
cap.

30. The combination of claim 29
wherein the movable member has an outer

5
C27

surface having a sliding interference fit with
an interior surface portion of the front end
portion of the tubular outer body which
frictionally supports the moveable member
with the exposed needle in an unretracted
condition.

31. The combination of claim 29
wherein the front portion of the tubular outer
body has a hub with an opening for
receiving a forward portion of the
unretracted retraction body and a stop for
the retraction body when the movable
member moves in response to the action of
closing said cap.

$$112^n$$

[Handwritten signature]

1. **Introduction**
 2. **Background**
 3. **Methodology**
 4. **Results**
 5. **Discussion**
 6. **Conclusion**
 7. **References**
 8. **Appendix**
 9. **Figure 1**
 10. **Figure 2**
 11. **Figure 3**
 12. **Figure 4**
 13. **Figure 5**
 14. **Figure 6**
 15. **Figure 7**
 16. **Figure 8**
 17. **Figure 9**
 18. **Figure 10**
 19. **Figure 11**
 20. **Figure 12**
 21. **Figure 13**
 22. **Figure 14**
 23. **Figure 15**
 24. **Figure 16**
 25. **Figure 17**
 26. **Figure 18**
 27. **Figure 19**
 28. **Figure 20**
 29. **Figure 21**
 30. **Figure 22**
 31. **Figure 23**
 32. **Figure 24**
 33. **Figure 25**
 34. **Figure 26**
 35. **Figure 27**
 36. **Figure 28**
 37. **Figure 29**
 38. **Figure 30**
 39. **Figure 31**
 40. **Figure 32**
 41. **Figure 33**
 42. **Figure 34**
 43. **Figure 35**
 44. **Figure 36**
 45. **Figure 37**
 46. **Figure 38**
 47. **Figure 39**
 48. **Figure 40**
 49. **Figure 41**
 50. **Figure 42**
 51. **Figure 43**
 52. **Figure 44**
 53. **Figure 45**
 54. **Figure 46**
 55. **Figure 47**
 56. **Figure 48**
 57. **Figure 49**
 58. **Figure 50**
 59. **Figure 51**
 60. **Figure 52**
 61. **Figure 53**
 62. **Figure 54**
 63. **Figure 55**
 64. **Figure 56**
 65. **Figure 57**
 66. **Figure 58**
 67. **Figure 59**
 68. **Figure 60**
 69. **Figure 61**
 70. **Figure 62**
 71. **Figure 63**
 72. **Figure 64**
 73. **Figure 65**
 74. **Figure 66**
 75. **Figure 67**
 76. **Figure 68**
 77. **Figure 69**
 78. **Figure 70**
 79. **Figure 71**
 80. **Figure 72**
 81. **Figure 73**
 82. **Figure 74**
 83. **Figure 75**
 84. **Figure 76**
 85. **Figure 77**
 86. **Figure 78**
 87. **Figure 79**
 88. **Figure 80**
 89. **Figure 81**
 90. **Figure 82**
 91. **Figure 83**
 92. **Figure 84**
 93. **Figure 85**
 94. **Figure 86**
 95. **Figure 87**
 96. **Figure 88**
 97. **Figure 89**
 98. **Figure 90**
 99. **Figure 91**
 100. **Figure 92**
 101. **Figure 93**
 102. **Figure 94**
 103. **Figure 95**
 104. **Figure 96**
 105. **Figure 97**
 106. **Figure 98**
 107. **Figure 99**
 108. **Figure 100**
 109. **Figure 101**
 110. **Figure 102**
 111. **Figure 103**
 112. **Figure 104**
 113. **Figure 105**
 114. **Figure 106**
 115. **Figure 107**
 116. **Figure 108**
 117. **Figure 109**
 118. **Figure 110**
 119. **Figure 111**
 120. **Figure 112**
 121. **Figure 113**
 122. **Figure 114**
 123. **Figure 115**
 124. **Figure 116**
 125. **Figure 117**
 126. **Figure 118**
 127. **Figure 119**
 128. **Figure 120**
 129. **Figure 121**
 130. **Figure 122**
 131. **Figure 123**
 132. **Figure 124**
 133. **Figure 125**
 134. **Figure 126**
 135. **Figure 127**
 136. **Figure 128**
 137. **Figure 129**
 138. **Figure 130**
 139. **Figure 131**
 140. **Figure 132**
 141. **Figure 133**
 142. **Figure 134**
 143. **Figure 135**
 144. **Figure 136**
 145. **Figure 137**
 146. **Figure 138**
 147. **Figure 139**
 148. **Figure 140**
 149. **Figure 141**
 150. **Figure 142**
 151. **Figure 143**
 152. **Figure 144**
 153. **Figure 145**
 154. **Figure 146**
 155. **Figure 147**
 156. **Figure 148**
 157. **Figure 149**
 158. **Figure 150**
 159. **Figure 151**
 160. **Figure 152**
 161. **Figure 153**
 162. **Figure 154**
 163. **Figure 155**
 164. **Figure 156**
 165. **Figure 157**
 166. **Figure 158**
 167. **Figure 159**
 168. **Figure 160**
 169. **Figure 161**
 170. **Figure 162**
 171. **Figure 163**
 172. **Figure 164**
 173. **Figure 165**
 174. **Figure 166**
 175. **Figure 167**
 176. **Figure 168**
 177. **Figure 169**
 178. **Figure 170**
 179. **Figure 171**
 180. **Figure 172**
 181. **Figure 173**
 182. **Figure 174**
 183. **Figure 175**
 184. **Figure 176**
 185. **Figure 177**
 186. **Figure 178**
 187. **Figure 179**
 188. **Figure 180**
 189. **Figure 181**
 190. **Figure 182**
 191. **Figure 183**
 192. **Figure 184**
 193. **Figure 185**
 194. **Figure 186**
 195. **Figure 187**
 196. **Figure 188**
 197. **Figure 189**
 198. **Figure 190**
 199. **Figure 191**
 200. **Figure 192**
 201. **Figure 193**
 202. **Figure 194**
 203. **Figure 195**
 204. **Figure 196**
 205. **Figure 197**
 206. **Figure 198**
 207. **Figure 199**
 208. **Figure 200**
 209. **Figure 201**
 210. **Figure 202**
 211. **Figure 203**
 212. **Figure 204**
 213. **Figure 205**
 214. **Figure 206**
 215. **Figure 207**
 216. **Figure 208**
 217. **Figure 209**

the needle being retracted into the
hollow outer body by the action of closing
the cap, the needle being retained within
said body thereby preventing needle sticks.

33. The combination of claim 32 wherein the retractably mounted needle is releaseably held by a moveable member which is operated by the action of closing the cap to release the needle.

59
C37

35. The combination of claim 33 wherein the retractably mounted needle is mounted in a retraction body releaseably held by the movable member.

36. The combination of claim 35 wherein the movable member is a hollow tubular member having a front end portion and an open back end.

37. The combination of claim 36 wherein the retraction body is a discoid shaped member releaseably held in the front end portion of the movable member.

38. The combination of claim 37 wherein the discoid shaped member has an outer edge which is releaseably held by means of a sliding interference fit at the front end portion of the movable member.

39. The combination of claim 36 wherein the front end portion of the movable member is releaseably held by means of a sliding interference fit at the front end portion of the hollow body.

005759"40000000

40. A cap operated retractable
medical device combination comprising:

a tubular outer body having a back
end having an opening and a front end
portion;

* a cap mounted at the back end of the
outer body for movement between an open
position and a closed position relative to the
opening at the back end of the outer body;

a movable member slidingly
positioned in the tubular outer body, the
movable member being responsive to
movement of the cap from its open to its
closed position;

a retraction body associated
retractably with one end of the movable
member; and

whereby the retraction body is
dissociated from the movable member and
retained in the tubular outer body by the act
of moving the cap to its closed position.

47. A method of operating a retractable medical device, comprising the steps of:

providing a tubular outer body having a front end containing a retraction mechanism with a retractable needle and an open back end having a closeable cap;
retracting the needle by the action of closing the cap; and
retaining the retracted needle within the tubular outer body.

42. The method of claim 41 wherein the step of retracting the needle is performed by pressing the closeable cap against a movable member associated with the retractable needle.

43. The method of claim 42 wherein the retractable needle comprises a retraction body removably holding the needle, the retraction body being removably associated with the movable member and the step of pressing the closeable cap against the movable member includes the step of

006T50"4C9C995B

dissociating the retraction body from the movable member.

44. The method of claim 43 wherein the step of dissociating the retraction body from the movable member is accomplished by the steps of stopping the retraction body from moving forward while the movable member is moving forward in response to the step of pressing the closeable cap against the moveable member.

45. The method of claim 43 wherein the step of stopping the retraction body from moving forward while the movable member is moving forward is accomplished by the step of bringing the retraction body into contact with a structure in the front end of the tubular outer body.

46. The method of claim 43 wherein the step of stopping the retraction body from moving forward while the movable member is moving forward is accomplished by the step of slidingly separating an interface between the retraction body and the movable member.

006T60" 4239960



add
as)